Centers for Disease Control and Prevention

NIOSH Science Blog

Understanding respiratory protection options in Healthcare: The Overlooked Elastomeric

July 6, 2017 by Michael Bach PhD, RN

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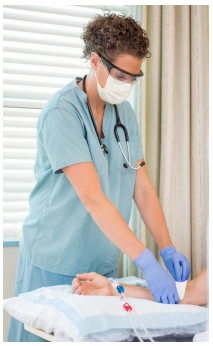
In the healthcare industry, the importance of respiratory protection is often overlooked. Choosing the correct respirator for the exposure level and work task is a critical component of a respiratory protection program. Most healthcare workers are aware of the N95 respirator but may not be aware that the re-formable, reusable elastomeric respirators are a viable option for respiratory protection. (Peterson et al., 2015). Elastomeric respirators with N95 cartridges have been used during aerosol transmissible disease outbreak emergencies like SARS as a reusable N95 respirator option. (CDC-NIOSH January 20, 2012) They are a cost-efficient and sustainable alternative when the demand for disposable respirators is excessive. This blog aims to educate healthcare workers and administrators about elastomeric respirators. A summary of various types of respiratory protection for the healthcare setting, including elastomeric respirators, is included below. It is important to understand the most suitable respiratory protection option given the potential hazards of a situation.

Surgical Masks



Surgical mask photo ©Shutterstock

Surgical masks are ***not*** respirators. They are disposable coverings designed to be loose-fitting over the user's nose and mouth. These loose-fitting masks leave gaps between the mask and the wearer's face through which harmful particles may pass. Since the Food and Drug Administration (FDA) does not address the fit function of masks and surgical masks are not NIOSH approved, the mask may not be used in situations covered by Occupational Safety and Health Administration (OSHA) within areas requiring the use of respiratory protection. Therefore surgical masks should never be used for protection against infectious aerosolized particles.

N95 Respirator and Surgical N95

N95 photo courtesy of Moldex

Both the N95 respirator and the surgical N95 are filtering facepiece respirators (FFRs) with an assigned protection factor (APF) of 10. The level of protection is the major difference between surgical masks and FFRs; the APF of 10 means the N95 reduces the aerosol concentration to 1/10 of that in the room and this equates to blocking 90% of airborne particles from being inhaled. (CDC-NIOSH, May 23, 2017). Both types of N95 respirators protect the user from aerosolized particles, whereas the surgical mask does not.

Standard N95: NIOSH-approved device (not FDA cleared). Used to reduce inhalation of aerosolized particles. Fit testing is required.

Surgical N95: NIOSH-approved and cleared by the FDA as a medical device. Meaning the protection characteristics are the same as the standard N95, except that the surgical N95 protects the sterile field, while protecting the worker with spray and splash resistance as well as flame resistance. Fit testing is required.

The most common type of N95 respirator is disposable and not designed for extended use. However, healthcare workers may be directed to re-wear these respirators, with specific directions, during emergency shortages (CDC-NIOSH March 13, 2014). For a true reusable respirator, an elastomeric or powered air purifying respirator should be considered.

Elastomeric Respirator

Photo Courtesy of Honeywell North

An elastomeric respirator is a reusable device with exchangeable cartridge filters that also has an APF of 10. The facepiece is made of synthetic or rubber materials that form a seal against the user's face, with properties that allow the original shape to be repeatedly reestablished if it is temporarily deformed. As the facepiece of the elastomeric respirator should form a tight seal against the user's face, just like the disposable FFRs, fit testing is still required. A particular challenge and potential benefit of an elastomeric air purifying respirator (APR) is that it may be disinfected through a process using a bleach water mixture. The ideal way to disinfect these respirators is with bleach and water. However, the use of bleach and water use is not practical between patients. Therefore, alcohol may be used for disinfection by wiping the exterior surface. The attached filtering cartridge(s) is replaceable and can be easily changed (Bessesen et al., 2015). This makes the device valuable during times of high demand, such as during a pandemic. Unfortunately procedures for disinfection and decontamination within healthcare environments are not routine and must be established for the environment where elastomerics may be used. Further complicating its common use, many healthcare workers have never heard of the elastomeric respirator, which indicates that there is a great need for education about the option of this type of respiratory protection. Although OSHA considers the protective factor for the elastomeric FFR to be the same as the disposable standard N95 FFR, some health facilities use the elastomeric exclusively due to employee's perceptions of better fit. The elastomeric FFR may potentially cost less over time and may not create as much hospital waste as the N95 FFR due to the extended wear time. The elastomeric respirator offers a viable protection option that hospital administrators and healthcare workers may consider when updating respiratory protection programs.

Powered Air Purifying Respirator (PAPR)

PAPR photo courtesy of Max Air

The Powered Air Purifying Respirator (PAPR) is an additional option for consideration. These battery-powered respirators may have an OSHA APF of 25 for the loose-fitting PAPR facepiece, an APF of 50 for the tight-fitting half-mask PAPR, and an APF of 1000 for the full facepiece PAPR. The PAPR provides superior respiratory protection compared to FFRs and elastomeric respirators, but healthcare workers complaints have been associated with the physiologic and ergonomic impact of wearing the apparatus including restricting peripheral vision. Loose-fitting PAPRs may be used when fit testing fails or when facial hair is present. PAPRs also have higher initial costs and additional proprietary ancillary supplies (batteries, hoods) adding additional logistical challenges for product management.

What are your thoughts?

None of these devices provide absolute respiratory protection (NAS, 2006). Correct donning and doffing procedures are important to achieve suitable protection. Understanding the available types of respiratory protective devices and their correct use are important to the promotion of healthy working environments. Elastomeric respirator use is a practical option that may be considered for respiratory protection within healthcare institutions. Further discussion is needed to evaluate the pros and cons of instituting a strategy for the use of this type of respirator within the healthcare industry. Please use the comment section below to add your thoughts to the conversation. Does your institution have a strategy for adoption of elastomeric use? Do you see benefits? Drawbacks? Should elastomerics be considered as part of an overall strategy during a pandemic when demand for N95's exceeds available supply? Should elastomerics be part of hospital and public health stockpiles?

Michael Bach PhD, RN, is an American Association of Colleges of Nursing (AACN) Fellow with NIOSH

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References

Bessesen, M. T., Adams, J. C., Radonovich, L., & Anderson, J. (2015). Disinfection of reusable elastomeric respirators by health care workers: A feasibility study and development of standard operating procedures. American journal of infection control, 43(6), 629-634.

CDC-NIOSH January 20, 2012. Retrieved from: https://www.cdc.gov/niosh/npptl/topics/respirators /factsheets/respsars.html

CDC-NIOSH March 13, 2014. Retrieved from: https://www.cdc.gov/niosh/topics/hcwcontrols/recommendedguidanceextuse.html

CDC-NIOSH May 23, 2017. Retrieved from https://www.cdc.gov/niosh/npptl/topics/respirators/disp _part/n95list1.html

National Academy of Sciences (NAS), (2006). Reusability of facemasks during an influenza pandemic: Facing the flu. Committee on the development of reusable facemasks for use during influenza pandemic. National Academies Press: Washington, DC.

Peterson, K., Novak, D., Stradtman, L., Wilson, D., & Couzens, L. (2015). Hospital respiratory protection practices in 6 US states: A public health evaluation study. *American journal of infection control*, *43*(1), 63-71.

Additional Resources

- https://www.cdc.gov/niosh/docs/2015-117/default.html
- https://www.cdc.gov/niosh/docs/wp-solutions/2016-109/default.html
- https://blogs.cdc.gov/niosh-science-blog/2009/10/14/n95/
- https://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/RespSource.html

The Centers for Disease Control and Prevention is addressing questions related to the Coronavirus Disease 2019 through CDC-INFO and on their webpage. As such, this blog has been closed to comments. Please visit https://www.cdc.gov/coronavirus/2019-ncov/index.html. You can find the most up-to-date information on the outbreak and get the latest answers to frequently asked questions. If you have specific inquiries, please contact CDC-INFO at https://wwwn.cdc.gov/dcs/contactus/form or by calling 800-232-4636. If you have questions about PPE that are not related to Coronavirus Disease 2019, please contact us at PPEConcerns@cdc.gov.

July 6, 2017 by Michael Bach PhD, RN
COVID-19, Healthcare, Infectious Disease Resources, Respirators

22 comments on “Understanding respiratory protection options in Healthcare: The Overlooked Elastomeric”

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interesting, as a health care provider I had not heard of these and had little training in them. thank you

As a small woman with a small face, most respirators of whatever type are simply too big to fit well, no matter how adjusted. Currently available respiratory protection generally does not serve its purpose for those of us for whom it was not designed well enough to fit. Only greater consideration of variability of wearers’ sizes and a greater range of size options will address this shortcoming.

The elastomeric respirator in the picture has chemical cartridges. These cartridges do not provide any protection against particulates unless they have particulate prefilters. A picture of an elastomeric respirator with filters might be more appropriate for your otherwise excellent article.

Good Catch. Chemical cartridges are typically not used by healthcare workers. We changed the photo to represent an elastomeric that may be used within the hospital.

Thanks for your reply!

Actually, those are not chemical cartridges pictured. Those are P100 filters, equivalent to a HEPA filter, with a "shower cap" to protect the filter from water or bodily fluid splashes. This particular elastomeric facepiece, with accompanying P100 filter, is ideal for healthcare workers due to available scrub colors, exhalation diverter valve, and the aforementioned shower caps. It is less obtrusive to the patient than industrial elastomeric facepieces as it is available in hospital-friendly colors, diverts wearer's exhaled air away from patient's face, and it also clarifies voice communication with the built in speech diaphragm.

Thank you for drawing this to our attention. We have inserted a new photo in the elastomeric section.

I believe the elastometric respirators would be a valuable option for pre-hospital application such as EMS, EMA, fire, rescue etc as well as hospital based departments such as the ER, OR, and any unit that deals with airborne precautions. As a healthcare provider I would feel most comfortable using a elastometric respirator and it is my belief that with proper training, fittings, and upkeep a majority of healthcare workers would feel the same way. Well written article, thank you.

Does anyone know where I can find the NIOSH requirements for PAPR annual Training? Is hands on training a Requirement for PAPRs or can it be online education?

Hello Jon,
PAPR training is typically part of an institution's Respiratory Protection Program. The RPP is an annual training initiative to keep healthcare workers current on the facilities policies and procedures for respirator use. The PAPR is an air purifying respirator that is used for a specific purpose when other respirator choices do not suit the user or situation for proper respiratory protection. If possible please consult with your Education Department or Infection Control Manager about PAPR training in your facility. Also you may find the 2 links below helpful, specifically the "Hospital Respiratory Protection Program Toolkit": page 32 (Training), and the "Implementing Hospital Respiratory Protection Programs: Strategies from the Field" publication: page 29 (Chapter 3: Training and Fit Testing Challenges and Strategies).

https://www.cdc.gov/niosh/docs/2015-117/default.html

https://www.jointcommission.org/assets/1/18/Implementing_Hospital_RPP_2-19-15.pdf

Thank you for your question.

I've considered the option of using the elastomeric's but wonder what the life of the filters would be. You'd need to have a plan for changing them out and enough on hand.

Elastomeric respirators typically have an exhalation valve. Thus they should not be worn in a sterile field or other patient treatment areas where a surgical mask or surgical N95 (as described in this post) is necessary to provide patient protection.

As mentioned in the blog post and reiterated in your comment, only respirators cleared by the FDA should be used when a sterile environment is required. The elastomeric is a potential replacement for an N95 filtering facepiece respirator, not a surgical N95 filtering facepiece respirator.

OSHA guidance states "Surgical respirators (without exhalation valves) should be selected for use in environments where a sterile field must be maintained." (OSHA, 2015, page 25)

Please visit the following for more information on respirator use with exhaust valves:
Occupational Safety and Health Administration. (2015). Hospital respiratory protection program toolkit. OSHA publication, (3767-05). Retrieved from: https://www.osha.gov/Publications/OSHA3767.pdf (page 25)
CDC-NIOSH August 19, 2016 Retrieved from: https://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/respsource3healthcare.html, and
National Academy of Sciences (NAS), (2006). Reusability of facemasks during an influenza pandemic: Facing the flu. Committee on the development of reusable facemasks for use during influenza pandemic. National Academies Press: Washington, DC. (Page 31)

Thank you for your comment.

Hi,
As some Asian ladies with very slim face (too samll) for fitting the common Surgical N95.
Question 1 : Can they wear N95 (without FDA cleared) one with wearing Face-shield for nursign patient with Airborne precaution and Blood / body fluid spalsh is anticipated ?
Question 2 : same HCWs as Question 1, if they need to do the operation in an Airborne precaution case, whcih type of respirator can be worn?
Thanks

The following response comes from experts within the National Personal Protective Technology Laboratory.

You should consult the appropriate governmental agencies that regulate the use of PPE in your country for specific guidance (for example the State Administration of Work Safety). There are NIOSH-approved N95 respirators that would provide adequate respiratory protection, but not the splash protection of a surgical N95 filtering facepiece respirator. The use of a faceshield would compensate for the difference in respirators and actually add more splash protection than a surgical N95 filtering facepiece respirator because the faceshield also covers other mucous membranes (eyes, nose) and more facial skin. For an overall review of faceshield use and related issues, we have a recent publication: http://www.tandfonline.com/doi/abs/10.1080/15459624.2015.1095302.

In the United States, the Occupational Safety and Health Administration (OSHA) which is the U.S. government agency which sets and enforces occupational health and safety standards has a Bloodborne Pathogens standard. It states: "Masks in combination with eye protection devices, such as goggles or glasses with solid side shields, or chin-length face shields, shall be worn whenever splashes, spray, spatter, or droplets of blood or other potentially infectious materials may be generated and eye, nose, or mouth contamination can be reasonably anticipated." (Occupational Health and Safety Administration (OSHA) Blood Borne Pathogens Standard (Title 29 Code of Federal Regulations, Part 1910:1030 subpart (d)(3)(i)). [accessed July 14, 2015]; Available at https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10051). Again, check with the governmental agencies in your country if they have a comparable standard.

in my opinion, it is necessary to use elastomers in the hospital. but back again to hospital policy and also how big a hospital or hospital standard itself. but does a hospital like this have to use elastomers?

Has anyone seen the latest N95 respirators on the market? I haven't seen in stores but I understand that several members of Children's Hospital raved about the respirators ability to transform a depressing ambiance and overpoweringly melancholy environment like a sick kids room in to one of laughter and suspended reality. My buddy said the company is called ugly mug respirators. I haven't had time to look them up, but be my guest. Jim, my friend, even mentioned that they are in the process of creating a line of N95 masks in a smaller size...which might work great for someone like you, Gloria

All respirators used in the workplace with a respiratory protection program must be NIOSH-approved. NIOSH is not familiar with the product or company mentioned. The appropriate markings of a NIOSH-approved filtering facepiece are illustrated in NIOSH document 2013-138. At this time, NIOSH has not approved any filtering facepiece respirators by "ugly mug." Verification of whether or not a respirator is NIOSH-approved can be answered by looking at the NIOSH Certified Equipment List.

If the N95 Surgical Mask does not have an exhalation valve and protects the Sterile Field where does the exhalation breath of the wearer go? I am not that familiar with surgical FFR's.
Another question:
I am not clear about this statement (quoted below) in the explanation above:

"The level of protection is the major difference between surgical masks and FFRs; the APF of 10 means the N95 reduces the aerosol concentration to 1/10 of that in the room and this equates to blocking 90% of airborne particles from being inhaled."

Does an APF refer to level of protection meaning that the 10 will protect the wearer up to 10 times the PEL of the contaminant and If the concentration is more than 10 times the PEL a half-mask cannot be used. Also does the 95 refer to efficiency, meaning that a N95 is 95% efficient in it's filtering capacity? (what does the stated blocking of 90% refer to)?
Please Clarify, Thank you

With the Coronavirus being the most severe threat to public health in the world and there is a shortage of the disposable

N95 masks, would you recommend using Elastomeric Respirator coupled with with P100/P95/N100/N95 filters as a protection for the general public? Thanks!

> At this time, CDC is not recommending the use of face masks among general public for the novel coronavirus. For the general American public, who are unlikely to be exposed to this virus, the immediate health risk from 2019-nCoV is considered low at this time. While an elastomeric respirator provides the same level of protection as an N95 respirator, additional considerations should be made when selecting a respirator for non-occupational use. Please take a look at our blogs on non-occupational respirator use and selection. These blogs will provide you information on how to select the best respirator for you and links to NIOSH certified respirators: http://blogs.cdc.gov/niosh-science-blog/2018/01/04/respirators-public-use/ and https://blogs.cdc.gov/publichealthmatters/2019/06/picking-a-respirator/. You can also find a breakdown of the differences between surgical masks, N95 respirators and elastomeric respirators here: https://www.cdc.gov/niosh/npptl/pdfs/UnderstandingDifference3-508.pdf.

If you use an elastomeric half face respirator (EHFR) with removable filters* while treating covid-19 patients, how long can you use the same filter – one day only, or days to months ? Can the filters be removed daily, the face mask cleaned, and the filters carefully reattached (without a high risk of self inoculation)? Or can the filters be rotated after use, stored for 10 days (or however long it takes virus to become inactive), then reused? How many days is long enough to store the filters for the virus to inactivate? It has been suggested that in a crisis when disposable N95 and PAPR are not available, health care workers may need to consider alteernate strategies.** Is there any guidance on what is most safe and effective for use of EHFR with regards to filter changes?

*for example, the widely available P100 3M pink disc filters model 2091 or 2097, with a model 7502 mask
**for example, CDC has already released limited guidance on extended use and reuse of N95 disposable masks during a severe shortage

> A respirator used in the care of an infectious patient should be considered potentially contaminated with infectious material on the outside and a source of contact transmission for healthcare personnel or patients. Therefore, PAPR filters should be removed with minimal handling, and disposed of properly. Hand hygiene should always be performed after removing a respirator. (NIOSH. Pittsburgh, PA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2015-117, 2015 May; :1-82 https://www.cdc.gov/niosh/docs/2015-117/). Please consult the manufacturer's instructions to determine if your PAPR filter can be reused.
> Unless the manufacturer identifies a specified duration of use, the service life of all powered air-purifying respirator (PAPR) filters is limited by unacceptable contamination/soiling or physical damage. All PAPR filters should be replaced whenever they are damaged, soiled, or causing noticeably increased resistance which results in decreased airflow. Follow manufacturer's recommendations for specific information on the model you are using.
> For information on coronavirus disease 2019, please visit https://www.cdc.gov/coronavirus/2019-ncov/index.html.

Comments are closed.

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